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16. ABSTRACT

The effects of bridge painting operations on aquatic ecosystems were studied. Bioassays using *Daphnia magna*, *Physa gyrina*, *Selenastrum capricornutum*, fathead minnows, and rainbow trout were performed. The results indicate that both lead pigmented and paints pigmented with zinc compounds can cause toxicity. Biocides and cleaning detergent tested were highly toxic. A set of guidelines was developed to assist highway workers in determining and mitigating the impacts of bridge painting projects on the aquatic environment. The aquatic environment is broadly defined to include all beneficial uses of water and the habitat created by the water. In the guidelines, the aquatic setting is first determined, then the nature of the project, the Area of Potential Environmental Impact and the impacts of the project are determined. Finally, mitigation is discussed.

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Materials and Research

**THE TOXICITIES OF SELECTED
BRIDGE PAINTING MATERIALS
AND GUIDELINES FOR
BRIDGE PAINTING PROJECTS**

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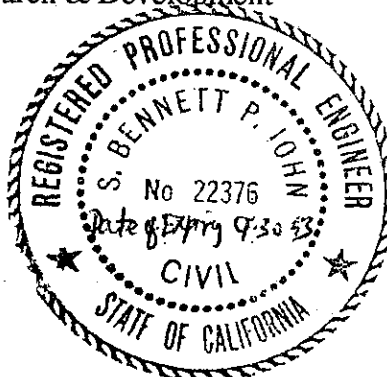
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CONVERSION FACTORS

English to Metric System (SI) of Measurement

Quality	English Unit	Multiply By	To Get Metric Equivalent
Length	inches (in) or (")	25.40 .02540	millimetres (mm) metres (m)
	feet (ft) or (')	.3048	metres (m)
	miles (mi)	1.609	kilometres (km)
Area	square inches (in ²)	6.432 x 10 ⁻⁴	square metres (m ²)
	square feet (ft ²)	.09290	square metres (m ²)
	acres	.4047	hectares (ha)
Volume	gallons (gal)	3.785	litre (l)
	cubic feet (ft ³)	.02832	cubic metres (m ³)
	cubic yards (yd ³)	.7646	cubic metres (m ³)
Volume/Time (Flow)	cubic feet per second (ft ³ /s)	28.317	litres per second (l/s)
	gallons per minute (gal/min)	.06309	litres per second (l/s)
Mass	pounds (lb)	.4536	kilograms (kg)
Velocity	miles per hour (mph)	.4470	metres per second (m/s)
	feet per second (fps)	.3048	metres per second (m/s)
Acceleration	feet per second squared (ft/s ²)	.3048	metres per second squared (m/s ²)
	acceleration due to force of gravity (G)	9.807	metres per second squared (m/s ²)
Density	(lb/ft ³)	16.02	kilograms per cubic metre (kg/m ³)
Force	pounds (lb)	4.448	newtons (N)
	kips (1000 lb)	4448	newtons (N)
Thermal Energy	British thermal unit (Btu)	1055	joules (J)
Mechanical Energy	foot-pounds (ft-lb)	1.356	joules (J)
	foot-kips (ft-k)	1356	joules (J)
Bending Moment or Torque	inch-pounds (in-lb)	.1130	newton-metres (Nm)
	foot-pounds (ft-lb)	1.356	newton-metres (Nm)
Pressure	pounds per square inch (psi)	6895	pascals (Pa)
	pounds per square foot (psf)	47.88	pascals (Pa)
Plane Angle	degrees (°)	0.0175	radians (rad)
Temperature	degrees fahrenheit (°F)	$\frac{^{\circ}\text{F} - 32}{1.8} = ^{\circ}\text{C}$	degrees celsius (°C)
Concentration	parts per million (ppm)	1	milligrams per kilogram (mg/kg)

NOTICE

The contents of this report reflect the views of the Division of New Technology, Materials and Research which is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

Neither the State of California nor the United States Government endorse products or manufacturers. Trade or manufacturers' names appear herein only because they are considered essential to the object of this document.

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EXECUTIVE SUMMARY

Introduction

The Water Quality and Solid Waste Branch of the California Department of Transportation's Division of New Technology, Materials and Research conducted research on the impacts to the aquatic environment of bridge painting materials. The study consisted of a literature survey of the subject and a bioassay study of materials used in bridge painting.

The objectives were to:

1. Determine the environmental impacts for existing paint systems and evaluate impacts of paint systems proposed for use.
2. Evaluate existing paint/abrasive system residue for disposal suitability.
3. Evaluate existing cleaning materials and abrasives for aquatic impact and develop a testing procedure to evaluate future materials.
4. Develop a method of analysis and reporting which addresses potential environmental impacts of a painting operation and which can serve as input for the environmental document.
5. Determine the toxicity of zinc spatter from an experimental cathodic protection system.

The materials tested were:

Black Beauty
Green Diamond
Starblast
EZ Blast
Kleen Blast
Lapis Luster and Clemco
PWB 80 paint
PWB 81 paint
PWB 83 paint

PB 197 paint

Basic lead silicochromate paint

Red lead/ aluminum paint

Vinyl paint

Blast sand contaminated with red lead /aluminum

Husky Clean Machine Formula #1

Dowicil 75

Skane M-8

Zinc spatter from an experimental cathodic protection system. This material is not to be confused with zinc-rich paints.

The formulations of the paints tested are found in Appendix III. New paint formulations were artificially aged in the laboratory. It is realized that the artificially aged paints may not have the same toxicity characteristics as paint in the field on a bridge.

Conclusions and Recommendations

The following conclusions are based on the literature search and the laboratory analysis. These conclusions should be carefully applied to individual projects.

1. At some concentration, all of the paints tested caused toxic effects in one or more of the five species tested.

When toxic amounts of paint will be generated, shrouding or other precautions should be used to prevent toxic concentrations of paint material from occurring in the aquatic environment.

The import of this conclusion should not be overly expanded. It does not mean that any paint system should be rejected for use because of this report. It means that all of the systems tested had a concentration above which toxic effects may be expected to occur. Nearly every substance has a concentration above which toxic effects may be expected to occur.

2. Both lead and zinc contaminated blasting abrasive wastes are likely to contain enough lead or zinc, respectively, to be classified as a hazardous waste under California Law. Other states with different legal and the federal government frameworks do not classify zinc bearing blasting abrasive waste as hazardous waste.